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MILITARY STANDARD

CALIBRATION AND MEASUREMENT REQUIREMENTS

AMSC F4562

AREA QCIC

DEPARTMENT OF DEFENSE
WASHINGTON DC 20402

Calibration and Measurement Requirements

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: AGMC/MLSR, Newark AFB OH 43957-5475, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1. SCOPE

1.1 Purpose: This standard describes the requirement to provide means for calibration and measurement traceability of all system, subsystem, and equipment parameters that must be measured to ensure system and equipment operational integrity and accuracy. It describes the process of establishing measurement traceability from actual system and equipment level measurement requirements to the National Institute of Standards and Technology (NIST) or other approved measurement sources. These measurement requirements are traced through properly selected and calibrated test, measurement, and diagnostic equipment (TMDE) or appropriate measurement sensors, through individual Military Department or commercial calibration facilities, to approved national measurement standards.

1.2 Applicability: The requirements of this standard apply to all systems, subsystems, and equipment that require measurement of any type to ensure proper operation.

1.2.1 Application guidance:

a. When Logistics Support Analysis (LSA), MIL-STD-1388-1 and Logistics Support Analysis Record (LSAR), MIL-STD-1388-2 are compliance documents on an acquisition program, the requirements of this standard should be an integral part of the LSA/LSAR effort. Data developed as a result of this standard should be documented in and become part of the LSA documentation and LSAR. Work accomplished and data developed shall not duplicate any other effort or data developed by the contractor.

b. When LSA and LSAR are exempted or their application tailored to exempt development of the data requirements in this standard, this standard can become an independent compliance document on the acquisition program and tailored in accordance with the contract.

1.3 Relationship to MIL-STD-45662: Calibration System Requirements MIL-STD-45662 requires the contractor to establish and maintain a calibration system. That system is to control the accuracy of measuring and test equipment used to assure that supplies and services delivered to the Government comply with prescribed technical requirements. In contrast, this standard requires the contractor to identify the system calibration and measurement requirements, the measuring and test equipment, and the calibration equipment and standards needed by the Military Departments to maintain a calibration system. This Military Department calibration system is operated to control the accuracy of measuring and test equipment used to maintain the technical requirements of those supplies and services after they are delivered to the Military for use and consumption.

2. REFERENCED DOCUMENTS

The following documents and the documents referenced in the cited documents (first tier) form a part of this standard to the extent specified. All other are for guidance and information only.

2.1 Government Documents

2.1.1 Standards

MIL-STD-1388-1 - Logistics Support Analysis

MIL-STD-1388-2 - Logistics Support Analysis Record

MIL-STD-45662 - Calibration System Requirements

2.1.2 Other Government Documents and Publications.

TO 33K-1-100	-	TMDE Interval, Calibration and Repair Technical Order Reference Guide and Work Unit Code Manual
TB 43-180	-	Calibration and Repair Requirements for the Maintenance of Army Material
NAVAIR 17-35MTL-1	-	Metrology Requirements List
TM-10510	-	U.S. Marine Corps Electronics Test Equipment Listing
TO 33K-1-101	-	Technical Manual, Calibration Standards and Associated Equipment
NAVAIR 17-35NCE-1	-	Navy Calibration Equipment List (NCE)
MIL-HDBK-300	-	Military Handbook, Technical Information File of Support Equipment

2.2 Order of Precedence - In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

2.3 Source of Documents

a. Copies of listed military standards are available from the Department of Defense single stock point, Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

b. Copies of Air Force TO 33K-1-100, Army TB 43-180, NAVAIR 17-35MTL-1, TO 33K-1-101, MIL-HDBK-300, or NAVAIR 17-35NCE-1 should be obtained as directed by the contracting officer.

c. The Marine Corps Technical Manuals are available from HQMC, Technical Manual Sec., Washington, DC 20380-0001.

3. DEFINITIONS

For the purpose of this standard, the following definitions shall apply:

a. Calibration: A comparison between items of equipment, one of which is a measurement standard of known accuracy, to detect, correlate, adjust, and report any variation in the accuracy of the other item(s).

b. Support Equipment (SE): All equipment used in calibration and maintenance support of mission and operational equipment. Support equipment that provides for measurement traceability is normally designated as TMDE.

c. Test, Measurement, and Diagnostic Equipment (TMDE): Any system or device

used to test, measure, evaluate, inspect, or otherwise examine materials, supplies, equipment, or a system to identify or isolate (or both) any actual or potential malfunction, or to determine compliance with specifications established in technical documents (research, development, test, and evaluation documents, specifications, engineering drawings, technical orders).

d. Measurement Traceability: The ability to relate individual measurement results through an unbroken chain of calibrations to a common recognized source. This is achieved by tracking a required system or equipment measurement accuracy through a more accurate measurement device that has been calibrated by a higher accuracy standard (as used in a Military Department calibration facility), ultimately reaching a recognized national standard.

e. Test Accuracy Ratio (TAR): The maximum permitted error of the unit to be measured or calibrated divided by the maximum known error of the measuring or generating device used to perform the measurement. For example, if it is required that a system or equipment output parameter be accurate to 8% (maximum permitted error) and the known accuracy (maximum known error) of the measuring device used to measure the output parameter is 2%, then the TAR is 4.

f. Military Department Calibration Facility: A military laboratory or equivalent facility that possesses and uses measurement standards and performs calibration and repair of designated TMDE.

g. Logistics Support Analysis (LSA): The selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the system engineering and design process, to assist in complying with supportability and other Integrated Logistics Support (ILS) objectives. (MIL-STD-1388-1, Logistics Support Analysis). The LSA process is a planned series of tasks performed to examine all elements of a proposed system to determine the logistics support required to keep that system useable for its intended purpose; and to influence the design so both the system and support can be provided at an affordable cost.

h. Logistics Support Analysis Record (LSAR): Documentation resulting from performance of LSA task conducted under MIL-STD-1388-1 pertaining to an acquisition program.

i. Support Equipment Recommendation Data (SERD): A data item used to identify and justify support equipment requirements.

j. Calibration and Measurement Requirements Summary (CMRS): A document which details the measurement requirements of a system, subsystem, or equipment; the test, measurement, and diagnostics equipment (TMDE); and the calibration standards and equipment required to assure traceability of all measurements through the individual Military Department's metrology and calibration programs to approved National Standards. It identifies and validates the adequacy of TMDE and the need for calibration standards and equipment.

k. Automatic Test Equipment (ATE) Unit Under Test (UUT) Interface: The point located on the ATE where all input and output signals are accessible for connection to an external UUT or calibration standard.

4. GENERAL REQUIREMENTS

4.1 The contractor shall assess system and equipment test and measurement requirements during all phases of design, development, and production. The contractor shall identify all parameters that must be measured to ensure proper and accurate operation of the system and equipment. The system shall be designed to reduce maintenance by keeping the frequency, number, and duration of the tests required to verify proper system operation to a minimum.

4.2 The contractor shall, by designing for testability, ensure ready accessibility of parameters which must be measured to verify proper and accurate system and equipment operation.

4.3 The contractor shall ensure that the system, equipment, and recommended support equipment technical documentation provide for measurement or verification of all parameters that must be measured in order to assure proper and accurate operation of the system and equipment.

4.4 The contractor shall plan for calibration support and measurement traceability of system, subsystem, and equipment measurement requirements during all design, development, and production phases of the contract. This planning effort and resulting documentation shall be maintained to current system and equipment configuration during performance of the contract and shall include all support TMDE.

4.5 The contractor shall impose the provisions of this MIL-STD on subcontractors and associate contractors. The list developed by subcontractors and associate contractors in 5. shall be maintained and integrated into the CMRS by the contractor.

5. DETAILED REQUIREMENTS

5.1 System, Subsystem, and Equipment Measurement Parameters.

5.1.1 The contractor shall develop a list of all system, subsystem, and equipment parameters that must be measured or tested to ensure proper system or equipment operation and accuracy, and to ensure intended mission goals are met.

5.1.1.1 This list of parameters shall be used by the contractor as the basis for recommending or selecting TMDE and developing support documentation.

5.1.1.2 This list of parameters shall portray the logical sequence of relationship within and between the system, subsystem, and equipment, and identify the parameters requiring measurement and verification.

a. System parameters are those parameters that require measurement and verification to ensure proper operation and nondegradation of the system so the mission requirements of the system can be accomplished.

b. Subsystem parameters are those parameters that require test and measurement to ensure interchangeability, proper operation, and nondegradation of the subsystem when integrated into the complete system.

c. Equipment parameters are those parameters that require test and measurement to ensure interchangeability, proper operation, and nondegradation of the equipment when used as part of or connected with the system or subsystem.

5.1.1.3 Description of measurement requirements. The system, subsystem, equipment,

assembly, module, or component that has parameters that require measurement shall be identified by nomenclature, manufacturer and manufacturer's code, part or model number, and type designation. If an item does not have an approved part number, but does have an approved or proposed end item specification number or system number, that number shall be referenced. For each item, the list shall identify:

a. Function: The function (specific input, output, or other characteristic which has units of measurement such as volts, frequency, power, current, length, force, etc.) which must be measured, tested, checked, or adjusted to determine or maintain the item's operational condition.

b. Operational Range or Specific Value: The range of values or actual value that shall be measured to satisfy the operational requirements.

c. Operational Tolerance: The accuracy requirements within which the equipment must perform to meet the operational specifications.

d. Interval: The contractor shall recommend a maximum time lapse between tests or other method of scheduling tests.

e. Parameters of Built-In Test (BIT) and Built-In Test Equipment (BITE), or other internal measurements which are part of the operational equipment requiring test or measurement: In such cases, nomenclature, manufacturer or code, part number or model number, range and accuracy of the item shall be identified, as well as the parameters being monitored or generated. When built-in references are employed, a method of test or measurement shall be identified or, if not required, a narrative justification shall be documented.

5.2 System, Subsystem, and Equipment Test Points. The contractor shall ensure measurements can be accomplished i.e., test points are identified in technical data, can be found in the system and equipment, and are accessible with minimum disturbance to configuration of the system and equipment.

5.3 Test, Measurement, and Diagnostic Equipment (TMDE).

5.3.1 TMDE. The contractor shall ensure that TMDE is recommended to satisfy all measurement requirements identified in accordance with 5.1.

a. The equipment recommended shall be capable of functioning in the system operational measurement environment and satisfy all parameters of each measurement in accordance with 5.3.3.

b. Documentation shall list TMDE specifications in support of measurement requirements identified in accordance with 5.1. Where several items of TMDE are used in combination, the overall test configuration specification and accuracy shall be listed.

5.3.2 TMDE in Support of other TMDE.

a. The contractor shall identify calibration equipment and standards required to support TMDE recommended in accordance with 5.3.1 which are not currently supportable (i.e. not listed with calibration procedures and intervals) by the applicable Military Department metrology and calibration program. Refer to Air Force TO 33K-1-100, Army TB 43-180, Navy NAVAIR 17-35MTL-1 or Marine Corps TM-10510

to determine TMDE supportability. Refer to Air Force TO 33K-1-101, Army TB 43-180 or Navy NAVAIR 17-35NCE-1 and MIL-HDBK-300 to identify existing Military Department calibration equipment and standards.

b. The calibration equipment and standards identified shall satisfy all parameters of each measurement in accordance with 5.3.3.

c. Documentation shall list specifications of the calibration equipment and standards used in support of other TMDE. Where several items are used in combination to support other TMDE, the overall test configuration specification and accuracy shall be listed.

5.3.3 Test Accuracy Ratio (TAR). Unless otherwise specified, the recommended TMDE shall be capable of measuring or generating to a higher accuracy than the measurement parameters being supported. A minimum TAR of 4 to 1 is required. The actual TAR shall be documented.

a. If a TAR of 4 to 1 cannot be achieved, the contractor shall analyze the measurement requirements and justify the lesser TAR.

b. A minimum TAR of 4 to 1 is required when an actual test is being conducted to characterize performance of operational equipment or to calibrate other TMDE.

c. A 4 to 1 TAR is not required when the TMDE only provides input stimuli which is not used to characterize performance of the operational equipment or other TMDE. In this case, the TAR does not need to be greater than 1 to 1.

5.3.4 Automatic Test Equipment (ATE).

5.3.4.1 ATE Design. The ATE performance specifications shall be more accurate than the system or equipment operational requirements. (See 5.3.3.).

5.3.4.2 ATE Technical Description.

a. The contractor shall identify the complete measurement and stimuli capabilities that can be made available at the ATE UUT interface.

b. The contractor shall identify the subset of ATE capabilities actually used for UUT testing.

c. Support equipment recommended for test, measurement, and calibration of ATE shall be selected to support ATE capabilities actually being used for UUT testing and ATE self testing.

5.3.4.3 ATE Calibration. The contractor shall identify all functions and parameters required for UUT testing, ATE self test, and calibration of the ATE. ATE calibration is implemented as a test program set (TPS) with the program running on the ATE host computer.

a. The calibration TPS shall measure the ATE parameters at the ATE UUT interface.

b. The ATE calibration TPS shall be structured to provide traceability of every calibrated function and parameter via external standards to approved national standards. To this end, external standards and calibrated ATE components, used as working or secondary standards, shall be used.

c. The calibration TPS shall be structured so that the accuracy of these ATE parameters are not stressed more than four times better than the most stringent UUT support requirement.

d. In the case of ATE that uses built-in calibration standards, these standards shall be identified with their full measurement and stimuli capabilities.

e. Calibration standards or calibration procedures used to support built-in standards shall be identified.

5.4 Technical Data.

5.4.1 The contractor shall ensure all system, subsystem, or equipment measurements required for operational integrity and accuracy are supported by appropriate test procedures or directions in the applicable technical documentation.

5.4.2 The test procedures or directions in the technical documentation shall show use of approved SE.

5.4.3 A cross reference shall be maintained between required system, subsystem, or equipment tests and technical documentation.

5.5 Calibration and Measurements Requirements Summary (CMRS). The data developed in 5. shall be used by the contractor to prepare a CMRS in accordance with 6.1.

6. NOTES

6.1 Data Requirements. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DOD FAR Supplement Part 27, sub-part 27.475-1 are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard is cited in the following paragraph:

MIL-STD Task Paragraph	Data Requirement Title	Applicable DID NO
5.	Calibration and Measurement Requirement Summary	DI-QCIC-80278A

(Data item descriptions related to this standard, and identified in section 6 will be approved and listed as such in DOD 5010.12-L, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2 Military Department Regulatory Documents

The documents listed are for information only:

AF Regulation 74-2 Air Force Metrology and Calibration Program

Army Regulation 750-25	Army Test, Measurement, and Diagnostic Equipment Calibration and Repair Support Program
NAVELEX 4355.2	Department of the Navy Metrology and Calibration (METCAL) Program
TO 00-20-14	Air Force Metrology and Calibration Program
TB 750-25	Maintenance of Supplies and Equipment: Army Test, Measurement, and Diagnostic (TMDE) Calibration and Repair Support Program
OPNAV 4790.2C	Naval Aviation Maintenance Program
TO 33-1-27	Logistic Support of Precision Measurement Equipment in FSC
MCO 4733.1	MARCOR Test, Measurement, and Diagnostics Equipment Calibration and Maintenance Program
SC-6625	Support Concept for MACOR TMDE

6.3 Subject Term (Keyword) Listing

Accuracy
Calibration
Checked
Measurements
Metrology
Parameters
Tests
Traceability
Specifications
Standards

6.4 Changes from previous issue. Vertical lines or asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - MI
Navy - OS
Air Force - 30

Preparing Activity:
Air Force - 30

(Project QCIC 0101)

Review Activities:
Army - AR, AT, AV, CR, SC, TM
Navy - AS, EC, MC, NM, SH, TD
Air Force - 11, 13, 14, 15, 16, 17, 18, 19, 25

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(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426

PREVIOUS EDITION IS OBSOLETE.

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